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SILVICAL CHARACTERISTICS of SHELLBARK HICKORY

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It often develops a relatively clean bole that may be free of branches for half its length. In forest stands it develops a narrow, oblong crown; when it grows in the open, the crown tends to be egg-shaped (8).

Measurements made on 87 trees growing in virgin stands in the Appalachians showed that it took 31 years for these trees to grow 1 inch in radius. Measurements of 41 old-growth trees in partially cut stands showed a growth rate of 1 inch in radius in 16 years. Eight second-growth hickories made an inch of radial growth in 11 years (18).

Ten-year diameter growth rates of the hickories as a group for three size classes in several of the Central States are given below (11, 12, 13, 14):

<u>State</u>	<u>Seedlings and saplings (Inches)</u>	<u>Poles (Inches)</u>	<u>Sawtimber (Inches)</u>
Illinois	1.22	1.24	1.52
Indiana	1.12	1.38	1.46
Kentucky	.70	1.22	1.44
Ohio	1.20	1.30	1.28

These growth rates include data from some of the slower growing species of hickory. The growth of second-growth shellbark hickory would probably exceed the above rates on many of the bottomland sites where it is found, especially in the South.

More conservative growth rates for this species are reported by Boisen and Newlin (3) for shellbarks cut in 1910. Ten trees from 200 to 300 years old averaged 16 inches in diameter and 95 feet in height. These trees were near Sardis, Mississippi. Ten trees near Napoleon, Ohio, at 130 years of age averaged 11 inches in diameter and 60 feet in height.

Reaction to Competition

Shellbark hickory is a very tolerant tree and, according to Cheyney (7), is exceeded in tolerance only by sugar maple, beech, and pignut hickory. Other reports (24) state that shellbark is the most tolerant of the hickories. Boisen and Newlin (3) agree with Cheyney except that they include shagbark with pignut hickory as being more tolerant than shellbark.

Shellbark hickory may be considered a very strong competitor in most of the species associations in which it is found. In fairly open stands where there is no more than partial shade, it can be

expected to reproduce very well and form clean boles. Although it will tolerate fairly heavy shade, growth is slow. And hickory for timber purposes should be fast growing to produce wood with desirable strength characteristics.

Climax Position

Because of its tolerance and ability to withstand competition, shellbark hickory must be considered as holding a high climax position on bottomland or other moist, fertile sites where it is found. One of the types where it is an associate (bur oak) (22) is classed as a pioneer type that is succeeded by northern pin oak or white oak-black oak-northern red oak mixtures in the northern part of its range. However, shellbark hickory is not an important constituent of this type.

The swamp chestnut oak-cherrybark oak type, which is found on sites where shellbark does well, is a climax type and here shellbark is a more important constituent than in the bur oak type.

ENEMIES AND HAZARDS

In general shellbark hickory has no important enemies that are limiting to its perpetuation in a stand or its development as a tree. Severe fire damage or other agents that cause wounding of the bole and provide points of entry for wood-rotting fungi are detrimental and the tree suffers moderately from browsing by cattle and wildlife.

Insects

Trees of this species of hickory are sometimes seriously injured by attacks of borers and larvae of moths (9). The hickory bark beetle (Scolytus quadrispinosus) feeds in the cambium under the bark. The tree is seriously weakened or even killed by these attacks, and products cut from affected trees are often degraded by bark pockets. In the early 1900's many hickories were killed by this insect (3).

Both standing trees and freshly cut hickory logs are very susceptible to attacks by wood borers. Even after seasoning, the sapwood is subject to damage from ambrosia and powder post beetles (9).

Williston (26) reports that in Mississippi a twig girdler (Oncideres cingulatus) seriously affects hickory reproduction by killing back the tops of seedlings and sprouts.

An important insect that attacks the nuts of all hickories is the pecan weevil (Curculio caryae) that is found from Connecticut west to Iowa and south to Florida. Another insect that attacks hickories throughout eastern United States is the living hickory borer (Goes pulcher). This borer feeds in the trunks and branches of the tree (9).

Diseases

Although shellbark hickory is relatively free of serious diseases, like most hardwoods it is host to a variety of fungi (1, 4, 6). The tree is very susceptible to bole injury from fire, and fungus infections often follow fire injury. More than 100 fungi attack the hickories and pecans (6). These include leaf diseases, bark cankers, wood rots, and root rots.

Birds and Animals

The nuts produced by this hickory are large and sweet and thus are very attractive to birds and animals as a source of food. Martin, et al. (16) report that shellbark hickory nuts are a minor source of food for the mallard duck, wood duck, quail, and the wild turkey. The nuts or the flowers are eaten by the crow, rose-breasted grosbeak, blue jay, white-breasted nuthatch, yellow-bellied sapsucker, and red-bellied woodpecker.

Mammals that feed on the nuts, as well as the bark in some cases, include black bear, gray fox, red fox, cottontail rabbit, raccoon, eastern gray and fox squirrels, eastern chipmunk, and white-footed mouse. The white-tailed deer feeds on the foliage, twigs, and nuts (5, 16).

Weather

Hickories as a group are resistant to damage from glaze storms (1), but shellbark hickory is reported to be very susceptible to frost damage (3). Baxter (1) reports that hickory and other trees died in large numbers in Iowa from the effects of the drought of 1934. More recently drought damage has occurred over a much wider area and affected a number of species.

RACES AND HYBRIDS

No records of races of shellbark hickory are recorded but several hybrids are known. Little (15) lists Carya x dunbarii as a hybrid of C. laciniosa x ovata, and C. x nussbaumeri as a hybrid of C. illinoensis x laciniosa.

SPECIAL FEATURES

The bark of shellbark hickory is very similar to that of shagbark hickory except that the plates are less curved and loose appearing. The bark has a lower tannin content than pecan, sand, bitternut, and pignut hickories, but higher than mockernut or shagbark (17).

The leaves of this tree are larger than any of the other hickories and vary from 15 to 22 inches in length (19). A striking feature of this tree is the presence of old leaf stalks upon twigs of the previous summer's growth (8).

Epicormic branching is moderately serious for this species in cases where trees are released from heavy competition.

TREE SPECIES MENTIONED

White ash	-	<u>Fraxinus americana</u> L.
Basswood	-	<u>Tilia</u> L.
Beech	-	<u>Fagus</u> L.
Blackgum	-	<u>Nyssa sylvatica</u> Marsh.
Cottonwood	-	<u>Populus</u> L.
American elm	-	<u>Ulmus americana</u> L.
Slippery elm	-	<u>U. rubra</u> Muehl.
Winged elm	-	<u>U. alata</u> Michx.
Bitternut hickory	-	<u>Carya cordiformis</u> (Wangenh.) K. Koch
Mockernut hickory	-	<u>C. tomentosa</u> Nutt.
Pecan hickory	-	<u>Carya illinoensis</u> (Wangenh.) K. Koch
Pignut hickory	-	<u>C. glabra</u> (Mill.) Sweet
Sand hickory	-	<u>C. pallida</u> (Ashe) Engl. & Graebn.
Shagbark hickory	-	<u>C. ovata</u> (Mill.) K. Koch
Shellbark hickory	-	<u>C. laciniosa</u> (Michx. f.) Loud.
American hornbeam	-	<u>Carpinus caroliniana</u> Walt.
Red maple	-	<u>Acer rubrum</u> L.
Sugar maple	-	<u>A. saccharum</u> Marsh.
Black oak	-	<u>Quercus velutina</u> Lam.
Bur oak	-	<u>Q. macrocarpa</u> Michx.
Cherrybark oak	-	<u>Q. falcata</u> var. <u>pagodaefolia</u> Ell.
Delta post oak	-	<u>Q. stellata</u> var. <u>mississippiensis</u> (Ashe) Little
Northern pin oak	-	<u>Q. ellipsoidalis</u> E. J. Hill
Northern red oak	-	<u>Q. rubra</u> L.
Pin oak	-	<u>Q. palustris</u> Muenchh.
Shumard oak	-	<u>Q. shumardii</u> Buckl.
Swamp chestnut oak	-	<u>Q. michauxii</u> Nutt.
Swamp white oak	-	<u>Q. bicolor</u> Willd.
Water oak	-	<u>Q. nigra</u> L.
White oak	-	<u>Q. alba</u> L.
Sweetgum	-	<u>Liquidambar styraciflua</u> L.

LITERATURE CITED

- (1) Baxter, Dow Vawter
1943. Pathology in forest practice. 618 pp., illus.
New York.
- (2) Betts, H. S.
1945. Hickory. U. S. Forest Serv., 10 pp., illus.
- (3) Boisen, Anton, and Newlin, J. A.
1910. The commercial hickories. U. S. Forest Serv. Bul.
80, 66 pp.
- (4) Boyce, John Shaw
1948. Forest pathology. Ed. 2, 550 pp., illus. New York
and London.
- (5) Brown, Louis G., and Yeager, Lee E.
1945. Fox squirrels and gray squirrels in Illinois. Ill.
Nat. Hist. Survey 23: 449-536, illus.
- (6) Campbell, W. A., and Verrall, A. F.
1956. Fungus enemies of hickory. U. S. Forest Serv.
Southeast. Forest Expt. Sta., Hickory Task
Force Report No. 3, 8 pp., illus.
- (7) Cheyney, E. G.
1929. Sylvics. 149 pp. Minneapolis.
- (8) Collingwood, G. H., and Brush, Warren D.
1947. Knowing your trees. 312 pp., illus. Washington.
- (9) Craighead, F. C.
1950. Insect enemies of eastern forests. U. S. Dept.
Agr. Misc. Pub. 657, 679 pp., illus.
- (10) Cruikshank, James W., and McCormack, J. F.
1956. The distribution and volume of hickory timber.
U. S. Forest Serv. Southeast. Forest Expt. Sta.,
Hickory Task Force Report No. 5, 12 pp., illus.
- (11) Hutchison, O. Keith
1956. Indiana's forest resources and industries. U. S.
Forest Serv. Forest Resource Report No. 10, 44 pp.,
illus.

- (12) Hutchison, O. Keith, and Morgan, James T.
1956. Ohio's forests and wood-using industries. U. S.
Forest Serv. Cent. States Forest Expt. Sta.
Forest Survey Release No. 19, 40 pp., illus.
- (13) ----- and Winters, Robert K.
1953. Kentucky's forest resources and industries.
U. S. Forest Serv. Forest Resource Report No. 7,
56 pp., illus.
- (14) King, David B., and Winters, Robert K.
1952. Forest resources and industries of Illinois. Ill.
Agr. Expt. Sta. Bul. 562, 95 pp., illus.
- (15) Little, Elbert L., Jr.
1953. Check list of native and naturalized trees of the
United States (including Alaska). U. S. Forest
Serv. Agr. Handb. No. 41, 472 pp.
- (16) Martin, Alexander C., Zim, Herbert S., and Nelson, Arnold L.
1951. American wildlife and plants. 500 pp., illus.
New York and Toronto.
- (17) Mitchell, Raymond L.
1955. Chemistry of hickory. U. S. Forest Serv. Southeast.
Forest Expt. Sta., Hickory Task Force Report No. 2,
12 pp.
- (18) Paul, Benson H.
1929. The relation of rate of growth to the production of
white wood in hickory trees. U. S. Forest Serv.
Forest Prod. Lab. Rpt. No. R1605, 4 pp.
- (19) Peattie, Donald C.
1950. A natural history of trees. 606 pp., illus. Boston.
- (20) Sargent, Charles Sprague
1933. Manual of the trees of North America. 910 pp., illus.
Boston.
- (21) -----
1947. The silva of North America, VII. 173 pp., illus.
New York.
- (22) Society of American Foresters
1954. Forest cover types of North America (exclusive of
Mexico). 67 pp., illus. Washington.

- (23) U. S. Dept. of Agriculture
1941. Climate and man. Agr. Yearbook 1941. 1,248 pp.,
illus.
- (24) U. S. Forest Service
1948. Woody plant seed manual. U. S. Dept. Agr. Misc.
Pub. 654, 416 pp., illus.
- (25) Westveld, R. H.
1939. Applied silviculture in the United States. 567 pp.,
illus. New York.
- (26) Williston, H. L.
1957. Personal communication. U. S. Forest Serv. South.
Forest Expt. Sta. Tallahatchie Forest Res. Center.

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This is a fourth of a series of 17 papers dealing with the silvical characteristics of forest trees important in the Central States region. The following species are included in this series:

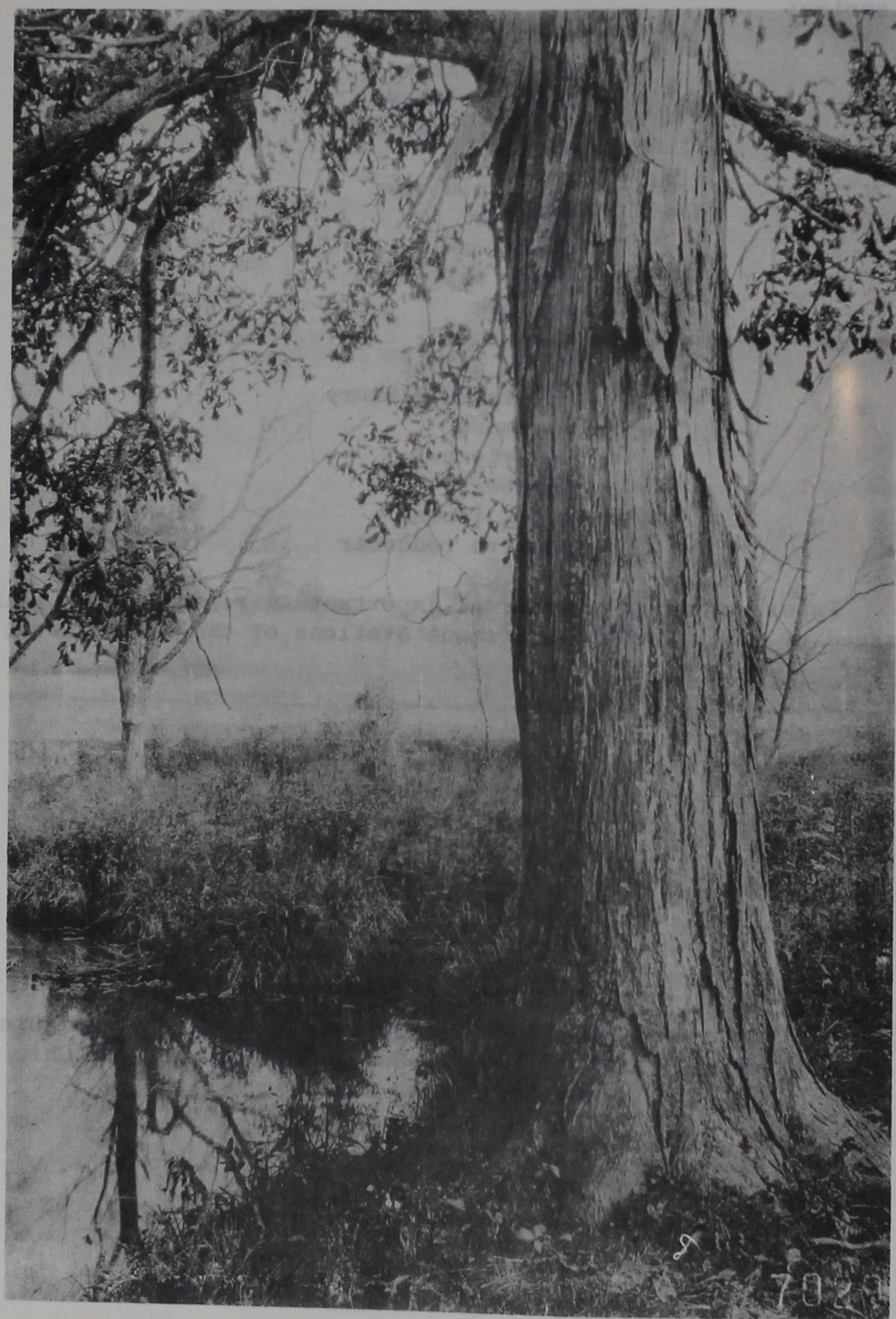
Ohio buckeye
Yellow buckeye
Northern red oak
Black oak
Chinkapin oak
Pin oak
White oak
Swamp white oak
Bur oak
Butternut
Black walnut
Shellbark hickory
Sycamore
Honeylocust
Hackberry
Black locust
Eastern redcedar

Papers covering additional important American species will be issued by other Forest Experiment Stations of the U. S. Forest Service.

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W. G. McGinnies, Director

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Silvical Characteristics

of Shellbark Hickory

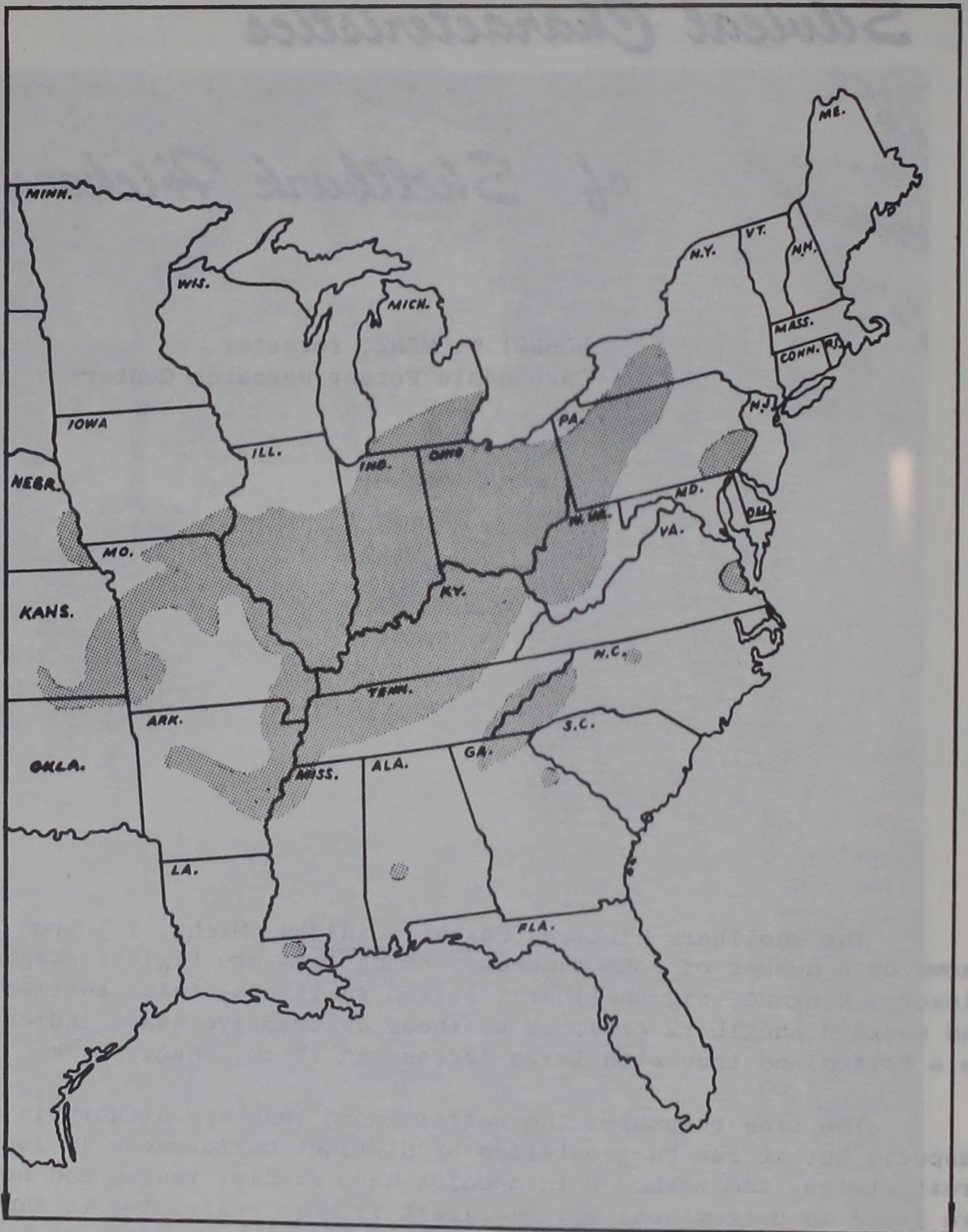
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The shellbark hickory (Carya laciniosa (Michx. f.) Loud.) is known by a number of common names. Among them are bigleaf shagbark hickory, kingnut, big shellbark, bottom shellbark, thick shellbark, and western shellbark (15)^{1/}. As these descriptive names indicate, it is a bottomland tree with large leaves and thick, shaggy bark.

The tree resembles the better known shagbark hickory in many respects but it can be identified by distinct differences in leaves, fruit, twigs, and bark. Both species have similar ranges and both are found in bottomlands but shellbark is more restricted to these sites than is shagbark. While shellbark wood is not quite as heavy as some of the other commercial hickories (except pecan), it is very strong, hard, and stiff with great shock resistance. Thus, along with other hickories, it is one of the best woods for handles, ladder rungs, skis, and other products requiring a strong, tough wood.

^{1/} Numbers in parentheses refer to Literature Cited, p. 12.

DISTRIBUTION



The tree is quite widely distributed but is nowhere common. Shellbark hickory is most prominent in the lower Ohio River region south along the Mississippi River to central Arkansas. It also is common in the great river swamps of central Missouri (21) and in the Wabash River valley to northern Indiana and Ohio (10).

SITE

Climate

Because shellbark hickory occurs from southern Michigan to southern Louisiana, and from the east coast in Virginia to central Kansas, it grows in a wide range of climatic conditions (23). The average annual temperature in this region varies from about 48° F. in the north to 68° F. in the south. Average maximum temperatures of 100° F. are found throughout this region and average minimum temperatures of -15° F. occur in the northern portion. The average annual precipitation varies from 30 inches in the northern and western portion of the range to about 58 inches in the southern extensions. Precipitation up to 80 inches per year occurs in western North Carolina where this tree is found. The average annual snowfall varies from 1 inch in the south to 40 inches in southern Michigan.

Soils

Shellbark hickory is essentially a bottomland species and develops best in deep, fertile, moist soils. In the South it is found on river terraces and on loamy flats in the "second" bottoms (25). It does not thrive in heavy clay soils but grows well in heavy loams or silt loams. For good development it requires moister situations than does pignut, mockernut, or shagbark hickories (2, 3, 8). The species will, however, grow in dry, sandy soils (2). In the northern part of its range it is found on south and west exposures of loamy soil and on dry, exposed, sandy plains. Its distribution under these conditions is limited to small areas.

In general hickories grow best on neutral or slightly alkaline soils (1).

Physiography

Although shellbark hickory may be found growing in a wide range of physiographic conditions, it grows best in the bottomlands where fertile soils and ample moisture are found. It usually grows on alluvial flood plains of the major rivers and streams within its range and it occurs on the ridges of the first bottoms along rivers in the northern part of its range. Land that is subject to shallow inundations a few weeks early in the growing season is also favorable for this species.

The species is also listed as an associate in timber types that are found on sandy plains, on loamy south and west slopes, and on black prairie soils from Ohio to Nebraska (22). These types are spotty in distribution and shellbark hickory probably occurs very infrequently on these sites.

Associated Species

Shellbark hickory may occur in pure groves consisting of groups of several trees, but more frequently it is found as scattered individuals in association with other hardwoods (7, 8).

The Society of American Foresters (22) lists it as an associate of the bur oak type and the swamp chestnut oak-cherry-bark oak type. In the bur oak type shellbark hickory is one of the associates with American elm, slippery elm, white ash, basswood, American hornbeam, swamp white oak, pin oak, red maple, and cottonwood. While some of these species are generally considered bottomland trees, this type is found on upland sites and on the edges of the prairie.

The swamp chestnut oak-cherrybark oak type is of widely varying composition and the named oaks may be only indicator trees as well as the most frequent species. Associated with these oaks and shellbark hickory in this type are white oak, Delta post oak, Shumard oak, water oak, several hickories (shagbark, mockernut, and bitternut), winged elm, blue beech (American hornbeam), blackgum, and sweetgum. This type is widely distributed in the South on alluvial flood plains, on all ridges in the terraces, and on the best fine sandy loam soils of the highest bottom ridges.

LIFE HISTORY

Seeding Habits

Flowering and Fruiting (24)

The genus Carya is monoecious, having staminate and pistillate flowers on the same tree. Shellbark hickory flowers from April to June. The staminate flowers are catkins developing from axils of leaves of the previous season or from the inner scales of terminal buds, located at the base of current year's growth. Pistillate flowers, 2 to 10 in number, appear in short spikes on peduncles terminating current year's shoots. The fruit is a dry drupe that ripens between September and November.

Seed Production and Dissemination

Shellbark hickory nuts are the largest produced by the several hickory species. The number of nuts per pound varies from 25 to 35. The seed is usually about 95 percent sound but occasionally it may be much lower for individual trees. Some seed is produced every year after the trees are 40 years old and good seed crops occur at least every 2 years. The optimum age for seed production is between 75 and 200 years; older trees are not dependable sources of seed. Thrifty trees may produce between 1 1/2 to 3 bushels of fruit in a good seed year (24).

Hickory seed is dispersed chiefly by gravity and by birds and animals. Animals that carry the seed away and bury it are valuable dispersing agents. On sloping land the large-sized nuts probably travel some distance downslope by gravity alone. Sound hickory seed will not float, so water cannot be considered of any importance as an agent for seed distribution.

Vegetative Reproduction

Shellbark hickory sprouts very readily when cut and coppice management has been recommended for this and other species of hickory (3). Furthermore, it is a persistent sprouter despite continued burning and grazing. No reports are available concerning the ability of this tree to root from cuttings. Graftings have commonly been made with pecan hickories for nut culture but no specific reports of graftings made with shellbark hickory are available.

Seedling Development

Establishment

Moist soils are required for the establishment of shellbark hickory. In this respect it is more exacting than all of the other hickories. Germination occurs from late April to early June. Nuts seldom remain viable when they are on the ground for more than 1 year. For nursery planting dormancy of the seed may be broken by stratification at temperatures of 32° to 45° F. for 120 to 150 days in moist sand, peat, sand and peat, or sandy loam soil (24).

Early Growth

Shellbark hickory is shade tolerant in early life and thus will reproduce under forest conditions. It soon develops a very strong taproot and for this reason is difficult to transplant. It is not a fast-growing tree in the seedling stage. However, in this stage it does grow faster than all of the other hickories except, possibly, the pecan. On red clay soil in open or lightly shaded conditions in the Ohio valley, the following comparative heights were observed for six species of hickory 4 years old (3):

	<u>Height</u> (Inches)
Shagbark	12.0
Pignut	12.0
Mockernut	12.5
Bitternut	13.3
SHELLBARK	16.0
Pecan	28.0

Sapling Stage to Maturity

Growth Rates and Size Attained

As a group the hickories are slow growers and probably are not as long-lived as the oak group. That shellbark hickory at least occasionally attains a very old age is attested, however, by a section of a tree in the American Museum of Natural History that has 340 annual rings (3).

According to Collingwood and Brush (8) and Sargent (20), shellbark hickory occasionally reaches a height of 120 feet and diameters that rarely exceed 3 feet. Cheyney (7) reports, however, that shellbark hickory grows to heights of 140 feet and to diameters of 40 inches.